Spor Eğitim Dergisi
http://dergipark.gov.tr/seder
e-ISSN 2602-4756 Cilt 4, Sayı 3, 54-63 (2020) Özgün Makale

Pliometrik Egzersizin Sedanterlerde Bazı Motorik Özelliklere Etkileri

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Özet

Yayın Bilgisi
Gönderi Tarihi: 01.09.2020
Kabul Tarihi: 15.09.2020
Online Yayın Tarihi: 15.09.2020

Bu çalışmanın amacı sedanter erkeklerde pliometrik egzersizin bazı motor özellikler üzerindeki etkilerini incelemektir. Otuz bir sedanter erkek (18 yaş, 70,1 ± 3,5 kg, 171 ± 5,2 cm) 8 hafta boyunca haftada üç gün pliometrik eğitim yapmıştır. Katılımcıların her biri rastgele pliometrik grup (PG) ve kontrol grubu (CG) olarak ayrıldı. Katılımcıların eğitim protokolü öncesi (Öntest) ve sonrası (Sontest) eğitim protokolü hız, statik güç, esneklik, statik denge, anaerobik güç özellikleri ve vücut yağ oranları belirlendi. Bu çalışma, 8 haftalık pliometrik egzersizlerin sedanterde hız, güç, esneklik, denge ve anaerobik güç gibi motor becerileri geliştirdiğini göstermiştir. Pliometrik grupta sıçrama, hız ve güç ön-son test karşılaştırmalarında anlamlı fark bulundu (p <, 05), esneklik ön-son test karşılaştırmasında anlamlı bir farklılık bulunmadı (p>, 05). Gruplar arası karşılaştırmada, PG'nin hız performansında KG'ye göre önemli bir artış olduğu görüldü. Sonuç olarak, pliometrik egzersizlerin motor becerileri geliştirmede etkili olduğu düşünülmektedir.

Anahtar Kelimeler
Egzersiz, Sürat, Anaerobik Güç

The Effects of Plyometric Exercise on Some Motor Abilities in Sedentaries

Abstract

Article Info
Received: 01.09.2020
Accepted: 15.09.2020
Online Published: 15.09.2020

The aim of this study was to examine the effects of plyometric exercise on some motor characteristics in sedentary men. Thirty-one sedentary men (18 years, 70,1±3,5 kg, 171±5,2 cm) performed plyometric training three days per week for 8 weeks. Each of the participants was randomly divided into pliometric group (PG) and control group (CG). The speed, static strength, flexibility, static balance, anaerobic power characteristics and body fat ratios of the participants before (Pretest) and after (Posttest) training protocol were determined. This study showed that 8-week plyometric exercises enhanced motor abilities such as speed, strength, flexibility, balance and anaerobic power in sedentary. In the plyometric group, a significant difference was found in jump, speed and power pre-post test comparisons (p <, 05), no significant difference was found in the flexibility pre-post test comparison (p>, 05). In the comparison between the groups, a significant increase was found in the speed performance of the PG compared to the CG. As a result, plyometric exercises are thought to be effective in improving motor skills.

Keywords
Exercise, Speed, Anaerobic Power

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Introduction

Physical exercise interventions that were originally planned for sedentary people only to increase aerobic capacity and overall strength have dramatically changed and diversified over the past several years. Growing scientific evidence showed that there are many strength and conditioning programs that can improve the different demands on the organism in terms of circulatory, respiratory, metabolic, and neurological functions (Silva et al., 2020; Thompson et al., 2013; Varathan, 2018).

One of them called plyometric training is a very popular form of physical conditioning that involves performing body weight jumping- type exercises (Bedoya et al., 2015; Davies et al., 2015; Stojanovic et al., 2017). Plyometric exercise requires a muscle is loaded and contracted in a rapid sequence. Likewise Markovic and Mikulic (2010) indicated that, plyometric exercise as a bridge between strength and speed.

There is a muscle-tendon component in this type of training as the muscle is lengthened while loaded (eccentric contraction) just prior to the contraction, producing greater force through the storage of elastic energy. The quick transition from the eccentric to the concentric phase is known as the stretch-shortening cycle (SSC) which is the main underlying mechanism of plyometric training (Flanagan & Comyns, 2008; Jeffreys et al., 2019; Turner & Jeffreys, 2010).

Regardless of the purpose of the program, for health, injury prevention, rehabilitation, strength, conditioning, and neurophysiological or for performance enhancement, plyometric exercise can be added to the exercise program (Ramirez-Campillo et al., 2020; Lloyd et al., 2011; Rössler et al., 2016). Additionally, it is well documented that plyometric exercises can be used to improve bone mineral density (Gomez-Bruton et al., 2017; Lin et al., 2012) prevent the risk of falls in elderly (Fragala et al., 2019) and counteract the loss of muscle power, strength and physical fitness performance (Bedoya et al., 2015; De Villarreal et al., 2010; Kramer et al., 2018). As with performance athletes, adding plyometric exercise into the sedentaries' exercise program can be helpful to achieve these positive effects. It is thought that the characteristics such as strength, flexibility and balance expected to be developed with plyometric exercises will be important data in terms of predicting the preventing from injuries and health status for sedentaries.

In this study, it was aimed to investigate the effect of 8-week plyometric exercises on motor abilities such as speed, strength, flexibility, balance and anaerobic power in sedentary.

Material and Method

Tests and training protocols were introduced to the participants 1 week before they started. The study was explained to all participants and the volunteer consent form was signed. Two days after the introductory week, the participants completed all the tests in the study at one-day intervals. During the tests and training protocols, the participants were not involved in any other physical activity or training. Each of the participants was randomly divided into pliometric group (PG) and control group (CG). Speed, strength (plank), flexibility, and vertical jump performances of the participants before (Pre-Test) and after (Post-Test) 8-week training protocol were determined. All performance tests and training protocols in the study were applied in a synthetic floor gym with a temperature of 20-24 ^{0}C. Participants were encouraged to perform at their maximum during the tests. Participants were asked to maintain their normal dietary intake during the study, not to consume any ergogenic supplements and alcohol, and to maintain their sleep patterns. Participants stopped food intake (except water) 2 hours before testing and training. Before the tests, a general warming protocol lasting 15 minutes was applied to the participants. Immediately after warming up, an active rest period of 2 minutes was given and immediately afterwards, vertical jump, flexibility, speed and static force tests were applied sequentially. After the tests were completed, training protocols were applied to the participants as 8 weeks, 3 days / week, 45 minutes / day. During this period, the participants in the CG did not engage in any physical activity. Two days after the training protocols were completed, the tests were repeated in the same way (Figure 1).

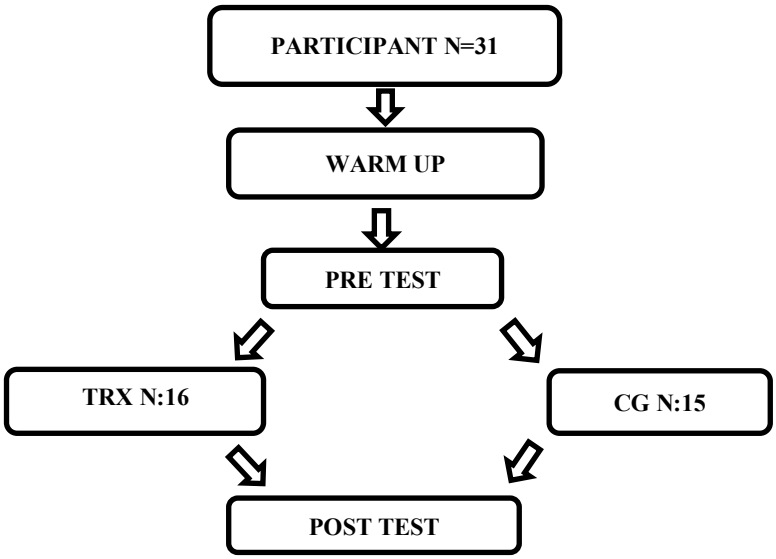

Figure 1. Experimental Procedure

Participants

31 sedentary men who do not do any regular physical activity voluntarily participated in our study. The age, height, weight mean and standard deviation of the participants are 18.23 ± 2.35 years, 70.1 ± 3.5 kg, and 171 ± 5.2 cm in height, respectively. Participants were informed about the tests and training protocols and filled out a voluntary consent form prepared in accordance with the Declaration of Helsinki.

Pliometric Training Protocol

The training program applied to the PG was prepared based on the information in the literature (Murat et al., 2007). Participants made a 10-minute general warm-up before each training session and then applied the training program shown in Table 1. In the "jump rope" movement, the maximum number of jumps of two feet or one foot was requested within 1 minute according to the command.

Table 1. Pliometric Training Protocol

Week	Exercise Type			The Number of Repetitions			The Number of Sets	Rest Between Sets (Sn.)
Week 1	1*	4	8	-	10	10	2	60
	2	5	11	10	10	10		
	3	6	10	10	10	10		
Week 2	1*	20**	8	-	10	10	2	60
	2	5	11	10	10	10		
	3	6	10	10	10	10		
Week 3	1*	4	11	-	10	10	2	60
	2	6	10	10	10	10		
	3	8	13	10	10	10		
Week 4	1*	21**	11	-	10	10	2	60
	2	6	10	10	10	10		
	3	8	13	10	10	10		
Week 5	1*	4	7	-	10	10	2	60
	2	8	10	10	10	10		
	3	9	12	10	10	10		
Week 6	1*	13	16	-	10	10	2	60
	7	10	14	10	10	10		
	9	12	15	10	10	10		
Week 7	1*	13	14	-	10	10	2	60
	20**	12	15	10	10	10		
	21**	16	19	10	10	10		
Week 8	1*	16	19	-	10	10	2	60
	10	14	18	10	10	10		

	13	15	17	10	10	10

* The duration is calculated instead of the number of repetitions. They were asked to do a maximum of repetitions for 1 minute. ** Every sit-up and bench press move in training is considered a jump. Each of the numbers in the exercise type column determines the number of exercises used in the workout.

1. Rope Jump: Athletes jump with the ropes in their hands, double feet, one foot according to the commands.

2. Double Foot Jumping Without Using Arms: Athletes jump with double feet where they are, arms at the sides without pulling their feet to the abdomen.

3. Double Leg Jumping Using the Arms: Athletes jump using double foot arms where they are, without pulling their feet to the abdomen.

4. One-Leg Tab (Right and Left): Athletes will bounce the specified number of bounces forward. They use their other feet in the turn.

5. Side Bounce Over Obstacle: Jump sideways over the funnel. As you pass over the funnel, pull your knees towards your stomach. Make this movement left and right.

6. Change Direction with Long Jump: 3 funnels placed in various directions. Funnels are 10 m ahead of the jump place. Stand with feet shoulder-width apart and in a half-squat position. Jump as forward as possible, swinging your arms from behind to front. As soon as you hit the ground, sprint to a funnel 10 m ahead in any direction.

7. Hexagonal Work: Hexagonal line with sides 1 m on a flat surface. Stand in the center of the hexagon and feet shoulder-width apart. Jump a pair of feet from the center to line 1 and return in the same way. In this way complete the hexagon respectively.

8. Changing direction with Sprinting by Leaping Over Funnel: 6 funnels placed in rows, 3-4 feet apart. Feet shoulder-width apart in front of the first funnel. Start by jumping a double foot. Return to your place by leaping from the last funnel (while in the air) and sprinting 5-6 steps in the direction indicated by the trainer (right-left).

9.180^0 Rotational Funnel Jumps: 6 funnels (basketball sideline) spaced 2-3 steps apart at intervals on a line. Stand next to the starting funnel as shown. Take your leap, spin 180^0 in the air to fall between the funnels. Likewise, turn 180^0 to finish the funnels.

10. Pushing the Body Up by Changing the Feet: 1 safe 30 cm high. Your left foot is on the case (your heel is at the end of the case), your right foot is on the ground. Try to reach as high as possible with your foot on the case. Switch feet while up and think with the right foot on the case and the left foot on the ground. Use both hands so that you can rise and stay balanced.

11. Bounce to the Safe: 1 safe 30 cm high. Stand with feet shoulder-width apart and facing the chest. From the half-squat position, using both arms, step on the case and jump.

12. One Leg Depth Jump: 1 safe 45 cm high. With your toes close together, fall over the case with one foot on the ground and jump as high as possible with the same foot (make the jump with your foot on the ground as quickly as possible). Then use your other foot.

13. Quick Jump: 1 safe, 50 cm high. Stand in front of the case with feet shoulder-width apart. With the help of the arms, jump a double foot on the case. As soon as you land on the case in a half squat, jump

forward immediately. Jump up as much as possible and make a reverse spring motion in the air. Put two feet on the ground.

14. Depth Jump Between Right Leg and Crates: 5 crates 40 cm high. The distance between the cases is 50 cm. Stand in front of the First Vault. Finish the crates by jumping over and over the case with your right foot.

15. Depth Jump Between Left Leg and Crates: 5 crates 40 cm high. The distance between the cases is 50 cm. Stand in front of the first safe. Finish all the crates by jumping over and over the casing with your left foot.

16. Depth Jump Between Double Legs and Boxes: 5 crates, 40 cm high. The distance between the cases is 50 cm. Stand in front of the First Vault. Finish all the cases by bouncing onto the floor and over the case with two legs.

17. Depth Leap Between Crates at Increasing Height with Right Foot: 5 crates, 40, 50, 60, 70, 80 cm high. The distance between the cases is 50 cm. Stand in front of the first safe. Finish all the crates by jumping over and over the casing with your right foot.

18. Depth Jump Between Crates at Increasing Heights with Left Foot: 5 crates, 40, 50, 60, 70, 80 cm high. The distance between the cases is 50 cm. Stand in front of the first safe. With your left foot, jump over and over the case to the ground and finish all the cases.

19. Depth Jump Between Cases Increasing with Double Legs: 5 crates with a height of 40, 50, 60, 70, 80 cm. The distance between the cases is 50 cm. Stand in front of the first safe. Finish all the cases by bouncing over and over the case with your two feet.

20. Medical Ball Shuttle: The athlete lies on his back and pulls his knees to his stomach. He holds the medicine ball on his head, his wife stands in front of her feet and throws the ball to her partner while doing the shuttle movement, while she reaches back again, her husband throws the ball to her.

21. Bench Press with Medical Ball: The athlete lies on his back with his arms stretched upwards, stands with a medicine ball in his hand on the equal case, drops the ball down. The other partner catches the ball and throws it up again.

Performance Tests

Vertical Jumping: The vertical jump performance sensitivity of the participants was measured using the Sport Expert TM, MPS-501 Power platform.

Speed Test: A wireless 2-door Sinar brand photocell device was used to measure the 30 meters speed of the participants. It was measured 2 times, 3 minutes apart, and the best scores were recorded.

Sit-Reach Test: Sit-and-reach flexibility bench was used to measure flexibility. The participant sits on the floor and stretches his legs, rests his soles on the front face of the coffee table, stretches his arms as far as possible on the metric panel on the upper surface of the coffee table, and waits for two seconds at the last point where his toes touch. The last point touched on the metric panel is determined and saved.

Strength Test: The time that the participants waited without disturbing the plank position was recorded in seconds.

Statistical Analysis

SPSS 23 package program was used for data analysis. The distribution of normality was done using the Shapiro Wilk test. In-group comparison dependent t test and between groups comparison independent t test was performed. The level of significance was determined as p <,05.

Results

Table 2. T Test Results for Dependent Groups Regarding the Difference in Pre-Post Test Scores of the PG

Test	N	X	ss	t	p
Pre-test Jump	16	34.38	9.27	-6.960	**.000**
Post-test Jump	16	40.69	10.16		
Pre-test Speed	16	4.57	.31	5.082	**.000**
Post-test Speed	16	4.42	.26		
Pre-test Flexibility	16	22.44	8.73	2.158	.048
Post-test Flexibility	16	20.94	8.42		
Pre-test strength	16	118.63	56.45	-5.138	**.000**
Post-test strength	16	127	58.69		

When Table 2 was examined, a significant difference was found in jump, speed and strenght pre-post test comparisons in the plyometric group (p <, 05), no significant difference was found in the flexibility pre-post test comparison (p>, 05).

Table 3. T-Test Results for Dependent Groups Regarding the Difference in Pre-Post Test Scores of the CG

Test	N	X	ss	t	p
Pre-test Jump	15	35,07	7,46	-2,086	,056
Post-test Jump	15	35,60	7,51		
Pre-test Speed	15	4,67	,27	-,193	,849
Post-test Speed	15	4,67	,27		
Pre-test Flexibility	15	20,60	8,50	-,202	,843
Post-test Flexibility	15	20,67	8,31		
Pre-test strength	15	115,40	72,46	1,344	,200
Post-test strength	16	113,13	67,54		

When Table 3 is examined, there was no significant difference in jump, speed, flexibility and strength pre-post test comparisons in the CG (p>, 05).

Table 4. Independent Sample T Test Results Regarding the Difference in Pre-Test and Post-Test Scores by Groups

Test	Group	N	X	ss	t	p
Post-test Jump	PG	16	40.69	10.16	1.58	.126
	CG	15	35.60	7.51		
Post-test strength	PG	16	127	58.69	.61	.546
	CG	15	113.13	67.54		
Post-test Speed	PG	16	4.42	.26	-2.6	**.014**
	CG	15	4.68	.27		
Post-test Flexibility	PG	16	20.93	8.42	.09	.929
	CG	15	20.67	8.31		

When Table 4 is examined, according to the results of the Independent sample t test, there is no significant difference between the jump, strength and flexibility posttest scores of the PG and the CG (p>,

05). However, the speed posttest scores between the groups showed a significant difference in favor of the PG (t = 2.6, p <, 05). While the average of posttest scores of the PG is 127, the average of the posttest scores of the CG is 113.13. This finding can be interpreted as the experimental procedure applied to PG improved the speed parameter.

Discussion and Conclusion

The effects of Plyometric training on performance and health improvement not only in athletes but also in sedentary individuals have been studied in recent years. It has an important place in training models for athletic performance enhancement, especially in sports. However, studies examining the importance of these positive effects for sedentary people are insufficient in terms of the literature. In this context, In this study, it was aimed to investigate the effect of 8-week plyometric exercises on motor abilities such as speed, strength, flexibility, balance and anaerobic power in sedentary.

Luebbers et al., (2003) examined the effects of 7 weeks plyometric training on vertical jump and anaerobic power in physically active, college-aged men. They stated that 4-week and 7-week plyometric programs are equally effective for improving vertical jump height, vertical jump power, and anaerobic power when followed by a 4- week recovery period. Blattner and Noble (1979) showed that three times per week for 8 weeks plyometric training improved significantly in vertical jump capasity. Similarly, Clutch et al., (1983) showed that plyometric training made significant increases in vertical jump, except the group of weight lifters, who did no jumping. Adams et al., (1992) examined the effect of six weeks of squat, plyometric and squat/plyometric training on power production. They revealed that both training is useful to improve hip and thigh power production. Holcomb et al., (1996) tested the effect of a modified plyometric program in 51 college-aged men. The subjects trained 3 days a week for 8 weeks. All groups improved in both peak power and vertical jump. Rimmer and Sleivert (2000) conducted an 8-week training study consisting of 15 training sessions. They revealed that a sprint-specific plyometrics program can improve 40-m sprint performance to the same extent as standard sprint training, possibly by shortening ground contact time. Racil et al., (2016) conducted 12 weeks of plyometric exercise combined with high-intensity interval training (HIIT) for obese female adolescents. The plyometric+HIIT program induced greater improvements in squat jump performance than alone the HIIT program. Fernandez-Fernandez et al., (2016) conducted a study to investgate the effects of an 8-week plyometric training. They indicated that plyometric training was shown as an important stimulus for enhancing explosive movements in young tennis players.

There are also studies in the literature on health status and injury prevention. In Kubo et al., (2017)'s stduy; eleven subjects completed 12 weeks (3 days/week) of a unilateral training program for the plantar flexors. They performed plyometric training on one side and isometric training on the other side. This study results suggested that plyometric training (but not isometric training) enhances the extensibility of tendon structures during ballistic contractions and active muscle stiffness during fast stretching. Kramer et al., (2018) conducted study was to evaluate plyometric training can prevent deteriorating effects of physical inactivity. Study concluded that the plyometric exercises successfully prevented power and strength losses throughout 2 months of bed rest. Thus, according to Kramer et al., plyometrics can be recommended as an effective and

efficient type of exercise for sedentary populations, preventing the deterioration of neuromuscular performance during physical inactivity.

Contrary to the common literature, some studies have stated that plyometric exercises are insufficient to improve some skills. Thusly Gehri et al., (1998) conducted a study to determine which plyometric training technique is best for improving vertical jumping ability, positive energy production, and elastic energy utilization. Subjects (n=28) performed 12 weeks different plyometric training (squat jump, countermovement jump, and depth jump). The study resulted in significant increases in vertical jump height for all groups. But none of the training methods improved utilization of elastic energy.

In support of the general opinion in the literature; we showed that 8-week plyometric exercises enhanced motor abilities such as speed, strength, flexibility, balance and anaerobic power in sedentary. In conclusion; adding plyometric exercises to the sedentary exercise programs can improve motor skills and have a positive effect on their overall health.

Suggestions

In this study, the effect of 8-week plyometric training on some motoric properties in sedentary individuals was investigated. As a result of the study, it can be said that plyometric exercise improves motor characteristics in sedentary individuals. From this point of view, it is thought that ypliometric exercises can be used in exercises for a healthy life. Chronic effects of different plyometric exercise programs can be examined in different groups of subjects.

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